

About basalt production and ways to improve basalt product quality

Izkoriščanje bazalta in možnosti izboljšanja kakovosti bazaltnih proizvodov

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Abstract

In this article the current state of production and processing of basalts in Uzbekistan, the quality of the products and condition of basalt processing train of machines of industries are analyzed.

The reasons of low production level and basaltic rock processing, including low production potential of train of machines of basalt processing plants and insignificant choice, and ill-quality of products are identified.

Ways to increase the volume of basaltic rock production and product quality through cleaning the rock from sludge, hydroxide, salts and ashes (further sludge) are proposed. Opportunities of expansion of the range of the products by typification and application of new technologies on basalt processing are discussed.

Key words: basaltic rock, production, processing, product quality, product range, basalt clearance

Izveček

V tem članku se analizira sedanje stanje proizvodnje in predelave bazaltov v Uzbekistanu, kakovost proizvedenih bazaltnih izdelkov in tudi palete bazaltnih proizvodov, izdelanih v podjetjih za predelavo bazalta v republiki Uzbekistan. Ugotovljeno je, da je razlog za nizko stopnjo proizvodnje in predelave naravnega bazalta v nepomembnem gospodarskem področju in slabi kakovosti izdelkov.

Podani so načini povečanja obsega proizvodnje naravnega bazalta in izboljšanje kakovosti proizvedenega bazalta z izpiranjem gline.

Ključne besede: naravni bazalt, proizvodnja, predelava, kakovost izdelkov, paleta izdelkov, bogatenje naravnega bazalta

Introduction

The need of a national economy of the Republic of Uzbekistan for materials from local raw materials, to a large extent, is defined by broad use of composite and fire-resistant materials based on glass-like, carbon and ceramic substances, and other substitutes. However, not all above-mentioned materials are made in our republic, but products from them are widely used in household appliances, car manufacturing, aircraft construction, industry, etc. In this regard, in the XX century scientists of a number of the countries have offered a material, received from the mountain rock – basalt, environmentally friendly and harmless for health. Successes achieved by scientists and specialists of Russia, Germany, USA, Japan, India, China and some other countries long ago and successfully put into practice the use of basalt. Nowadays the opportunity of obtaining various types of valuable materials that are of huge use for mankind is not a secret ^[1-3].

Uzbekistan is one of the leading countries of the world with rich natural basalt resources. There are more than ten non-governmental basalt processing organizations in Uzbekistan; however 2 or 3 of them work continuously. Therefore, volume of basalt processing in Uzbekistan is about 25–30 t/d ^[1].

It is necessary to note that basalt processing plants of Uzbekistan, mainly, specialize on the production of basalt-fibrous materials which are used as heat insulation material. These plants lack good technical equipment and effective methods of basalt production. As a rule, time consuming methods of basalt mining that at the same time incur big expenses are used, and in practical terms, technological solutions directed to increase the product quality are not applied, which hinders the expansion of basalt products' choice.

Currently, country's need for heat-insulating fibers is completely met. Requirements put before this materials mostly include quality such as fire resistance and fire safety, temperature stability, water resistance and acidity, absence of gas emission when heated, low density and durability in the conditions of variable thermal and climatic loads, etc. don't conform to modern standards.

Field of application of the basalt products in the world market extends very intensively. Day after day there are new basalt products like basalt plates and mats, pipes and rebar, cardboards and sound absorbers, reinforcing and composite materials, metal substitutes and balls, and so forth. However, as it was noted above, the power of the existing enterprises on the basalt processing don't meet the requirements of domestic market.

Thus, significance of a problem of basalt mining increase and quality improvement is due to growth of needs for basalt production and steady demand for it, not only in our Republic, but also in the international market. That's why, efficiency of using rich basalt mines of Uzbekistan through increasing basalt rock mining, quality improvement and expansion of basalt products' choice, development of new currency-saving methods of basalt processing are now mostly important requirements. These will improve the quality of rocks' processing, facilitate the economic development of basalt processing plants of the Republic and create additional workplaces.

Materials and methods

Basalt winning

In Uzbekistan's nature, mainly surficial deposits of basalt rocks are observed; average diameter of each is about 250–300 mm. ^[1, 4]. Therefore, basalts are mined only opencast with the usage of baby blasting workings. After this, rocks are sent to plants' location wherein basalts are bucked to necessary fraction size.

Analysis of basalt winning processes in "Gavasay", "Asmansay" and "Aydarkul" shows that all basalt processing plants are located at some distance from the deposit. In some cases, this distance is about 700 km and more which in fact increase the cost for transportation of the raw material and influence on the net price of finished product. Share of other vehicles and other mining and processing equipment is not big. It is possible to note following reasons for such situation:

- frequent use of manual skills for unloading or loading works;

- use of technical means with a low productivity;
- use of non-standard melting or other equipment;
- small investments to the growth of productivity of basalt processing enterprises;
- small experience and absence of highly qualified specialists.

Frequent use of manual skills for unloading or loading works, application of nonconventional stripping methods are explained by plant management with low cost, the low power of the enterprise, shortage of means, semi-automated or automated loading and discharging equipment. In turn, application of non-standard melting ovens or other equipment, hindering the growth of enterprise's development is explained by the high cost of equipment of good quality, its delivery and assembly, and also low-level of investments in this area.

Researches showed that none of the advertising companies carried out an advertisement of domestic manufacturers-producers for the last 10–15 years. Building a basalt processing enterprise next to basaltic deposit is an actually costly process. Delivery of fuel and energy resources to mountainside and to area, and back to enterprise's location is not effective option for the solution of this question.

At the same time, development of the winning and production volume on basalt processing is impossible without the development of powerful train of machines on loading-unloading basaltic products. Basalt processing enterprises due to lack of financial resources so far cannot solve this problem. That's why, optimum alternative solution here is the use of modern methods of basalt winning, transportation and processing.

Considering the abovementioned, we propose following solution to be applied in the basalt production:

- to build basalt processing plants next to basaltic deposits;
- to find alternative production solutions to increase the domestic basalt winning;
- to use modern basalt processing methods;
- to apply new technologies, including initial rock processing on the deposit;

- to apply methods that provide the quality improvement of the raw material and eventually the final product which, in turn, will be cheaper in net price.

Quality improvement of basaltic rock

At the research, we have identified that after crushing, basaltic rocks are subject to melting process. Currently, plants are not designed to clean or sort the basaltic rocks.

The analysis of technological processes in this area shows that basaltic product manufacturers in our country think that sorting is not a necessary process as crumbles after crushing into particles are sent to melting furnace, and as a result they get low-quality basalt fibrous-heat insulating material. Such factor as: grain size and rock form; dust-like and cledgy particles in basaltic content; availability of hazardous rocks; availability of detrimental impurities in basaltic content; radioactivity and salinity of basalts, their typification and properties are not considered.

Absence in technical literature is revealed of data on influence of slimes on the quality of the basaltic fibrous materials that can cause early corrosion of insulated object. Producers of basalt products consider that the absorptivity of a basaltic crumbles doesn't influence on its further processing; the raw material doesn't deteriorate, and not influenced by an atmospheric precipitation. As a result basalt crumbles are often stored even in the open air. There is also no proof that the remained salts on heat-insulating basaltic-fibrous materials do not cause early corrosion of insulated object. At the same time, it is established that basalt fibrous materials intensively absorb water, crude air and become wet in hostile environment ^[4].

While studying basaltic-fibrous heat-insulating materials, after their use for several years, we have identified the corrosion on the surface of pipes. This phenomenon can be explained by the fact that basaltic rocks have been processed without cleaning the slimes from its content. Corrosion can be observed both underground pipes and ground pipes. The cause can be explained by the high water absorption of basaltic-fibrous materials and the availability of salt in the wool content.

As a rule, availability of slimes in basalts can be explained by the salinity of soil in basaltic deposits and rocks. According to the data, salinity of irrigated lands in our Republic is high, and this includes lands where big basaltic deposits are located. For example, average salinity of lands in Namangan region (“Gavasay” deposit location) reaches up to 28 %, Jizzakh region (“Asmansay” deposit) – 85.4 % and Navoi region (“Aydarkul” deposit) – 92.9 % [5-7].



Figure 1: Typical corrosion in long-term use of basaltic-fibrous materials for insulation.

Influence of salts on the quality, working capacity and durability of basaltic heat-insulating materials are studied through observing the pipelines in Navoi region where basaltic-fibrous heat-insulating materials of various diameter, produced by local manufacturers. Data and results of observation are given in Table 1. Big corrosion layer is observed on the surface of pipes which were traditionally wrapped around by basaltic heat-insulating, thickness of which is 50–80 mm. Also, we have revealed that corrosion layer under basaltic heat-insulating material with 100 mm reached 0.5 mm.

Study and analysis of the consequence of using heat-insulating materials, obtained from not refined basalts showed that they are inclined to corrosion. We also revealed that heat-insulating materials together with slimes salts like NaCl, KCl and CaCl. Such mixtures while remained in basaltic fibers easily cooperate with environment and with water space. High water absorption of absorption cotton causes corrosion. This, in turn, decreases the terms of using final product and object where they are used which provides early loss of useful properties of basaltic fibers and cause destruction of the equipment as well.

For final assessment of the rock quality, we studied the condition of basalts through experimental way. For this purpose, we selected rocks at random from “Gavasay”, “Asmansay” and “Aydarkul” with weight 200 kg from each. Samples of rocks were divided into two parts – 100 kg each. In the first part – 100 kg was put into sluicing process for cleaning the rocks from slimes.

Table 1: Study results of pipes surface corrosion resistance.

№	Thickness of basaltic heat-insulating material, [mm]	Relative degree of humidity of adjacent regions, 68–90 %		
		Corrosion layer thickness, after 5 years, [mm]	Corrosion layer thickness, after 8 years, [mm]	Corrosion layer thickness, after 10 years, [mm]
1	50	0.33	0.87	1.3
2	80	0.19	0.41	0.92
3	100	0.11	0.27	0.51

Table 2: Study results on the identification of corrosion time of metals while using “basaltic fiber”, obtained from various basalt deposits

№	Name of indicators	Deposits		
		“Gavasay”	“Asmansay”	“Aydarkul”
1	Corrosion starting time on pipes (basalt without refining), year	6–8	5–6	2–4
2	Corrosion starting time on pipes (basalt after refining), year	12	10–12	10–12
3	Corrosion starting time on the surface of working parts of equipment, year	5	3	1
4	Salinity level of basalt deposit soil, %	28	85.4	92.9
5	Corrosion starting time on the surface of working parts of equipment, year	12	12	12

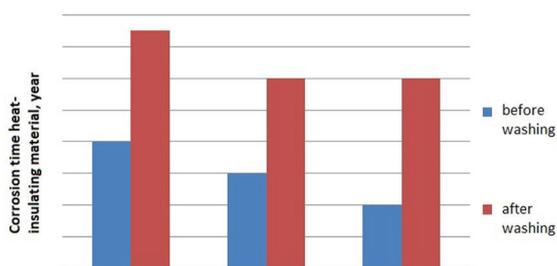


Figure 2: Histogram of objects' usage period when basalt fiber is used as heat-insulating material before and after washing-out the basaltic rocks: 1 – indicators of basaltic deposits in “Gavasay”; 2 – indicators of basaltic deposits in “Asmansay”; and 3 – indicators of basaltic deposits in “Aydarkul”.

First, we processed not-refined basalts and then refined basalt rocks underwent the experiment. Later, we wrapped pipes with obtained heat-insulating materials and observed. Experiment took 12 years – until the first appearance of corrosion layer on pipes. Study results are given in Table 2.

We found out that more slimes were removed from “Aydarkul” deposit rocks. Long-term use of materials was observed in basalts obtained from “Gavasay” deposit. Results are given in histogram in figure 2. Histogram shows that the earliest corrosion can be observed in object where fibers obtained from “Aydarkul” are used, that is maximum after 4 years and “Asmansay” – after 6 years. Results showed that if basalts rocks are refined and washed, then the appearance of corrosion can be prolonged to average 3.5 times which proves the idea

of efficiency of cleaning slimes from basaltic rocks.

Therefore, it is perspective to remove slimes from the surface of basalts by way of washing out with specialized equipment – wash trammel. Doing so, one can reach the decrease of time waste on the technological process. Such approach can be easily succeeded with the help of latticed wall of wash trammel which in this case plays a role as sieve, the size of which is matched to the size of basaltic rock particles simply.

After all, there is a practical interest in the quality indicators of basalts and their heat-insulating materials which prolonged the exploitation period of pipes to about 2 times (histogram, Figure 3)

It is established that quantity assessment of slime content in basaltic deposits of “Gavasay”, “Asmansay” and “Aydarkul” is of high priority. Each tested 200 kg of basaltic

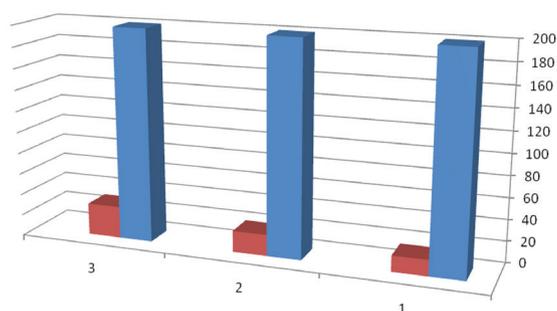


Figure 3: Indicators of mechanical cleaning basalts in “Gavasay”, “Asmansay” and “Aydarkul” basaltic deposits.

rocks carry slimes, but in a different amount: “Gavasay” – 1 %, “Asmansay” – 1.5 % and rocks of “Aydarkul” – 2 %. In case is manufacturers want to get higher results, these indexes play very important role.

Analysis of the demand volume to the products of basalt processing plants shows that heat-insulating product from basalts are used in: energy industry, construction, road and automobile construction and so forth [2, 4]. At the same time, because of the difference of properties and material composition of basalts in various deposits, there is no opportunity for direct use of modern technologies in Uzbekistan. Therefore, one of the possible options of increasing the effectiveness of using basaltic raw material and organization of production of ecologically clean products it is necessary to develop rational technology of local basalt processing with the consideration of local deposits' soil salinity.

Altogether, new technologies of basaltic rock processing and new directions of using different products produced from basaltic rocks shows their infinite possibilities. Consequently, perspective direction of using basaltic primary resources of Uzbekistan and obtaining standard products are to conduct a thorough study of basalts and expand production potential of plants based on given parameters of properties, material composition and concentration of basalt mixtures. Doing so, to achieve the production of high-quality products of various purpose and saving currency means of the country.

Conclusion

Current status of mining and quality of basalt product in Uzbekistan are studied. As a result, we have established unprofitable use of basaltic primary resources, low quality of basalt products and limited variety of product. Additionally we have found that infinite opportunities of using local basaltic rocks.

It is also established that volume of basalt winning can be increased by following ways:

- improving train of machines based on the existing one;

- improving existing technologies on the basalt processing and modernization of present equipment;
- increasing the volume of production on the processing and production of basaltic products with the use of new technologies, based on the creation of administered production in total which paves an opportunity to sparingly and thinly spend energy resources and ease the zero-emission processing of basaltic rocks;

Expansion of product variety can be fulfilled though:

- basalt typification based on given parameters of properties, material composition and cleaning basaltic rocks from slimes;
- rock sorting on the processing stage which improves the useful properties of basalt products' durability;
- development of rational technologies on obtaining basaltic products in a wide array of choices and with given physical-chemical parameters and their application in the problem solving of different tasks;
- creation of new types of basaltic products with improved properties: fire-resistant, corrosion-resistant, dielectric permittivity, water-absorption and water-yielding capacity, acid-resistant, alkaline-resistant, porosity, thickness, solidity, and so on;
- development of new methodology and recommendations on the study and use of basaltic products for their practical application in the agriculture of Uzbekistan, countries of CIA, and particularly in enterprises of mining and smelting branch.

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